Application Serial No. 09/702,493
Amendment Dated September 15, 2003
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Remarks

Claims 1-4, 16, 19 and 21-23 remain in the application, and re-examination and reconsideration of the application are respectfully requested.

Claims 1-4, 16, 19, and 21-23 are rejected under 35 U.S.C. §103(a) as being unpatentable over Nojima (5,812,355) in view of Ohtsuka (5,737,172). Ohtsuka relates to an electromagnetic contactor that can be connected to different voltages and further, can control movement of a movable iron core in order to mitigate the physical impact of the movable core colliding with a fixed core. As described at col. 9, lines 20-30, a timer 16 (Fig. 3) is used to switch a pulse computing circuit from a higher current closing operation defined by the time period T_1 of Fig. 6 to a lower current maintenance operation.

Referring to Fig. 2, current through a magnetic coil 120 of the contactor is controlled by the operation of switching elements 1 and 2. As shown in Fig. 6, the operation of switching element 1 is indicated by the curve (d); and the operation of switching element 2 is indicated by the curve (e). The resulting current in the coil 120 is illustrated by the curve (f). During the closing operation T_1, if the pulse width modulation of the second switching element results in longer on-times as indicated by pulses g and h of curve (e), the magnitude of the current in the coil 120 increases as shown in curve (f). However, if the pulse width modulation of the second switching element 2 results in lesser on-times as indicated by pulses i and j, the resulting magnitude of current in the coil 120 is reduced. As will be described, the pulse widths of pulses from the second switching element 2 vary in accordance with particular operational conditions to provide a varying current magnitude within the coil 120 during a closing period having a duration T_1.

During the closing operation, the variation in pulse widths is described at column 13, lines 13-23. As shown in Fig. 4, a reference triangular wave curve G is provided by the reference triangular wave generating circuit 50 of Fig. 3. Reference levels P and Q are provided by the closing pulse computing circuit 17 depending on the magnitude of the applied voltage. For example, if the

loaded voltage is lower, level Q provides an output H from comparator 83 with a larger duty cycle as indicated by the solid line in Fig. 4. But, if the loaded voltage is higher, level P provides an output H with a smaller duty cycle indicated by the dashed lines in Fig. 4. As shown in Fig. 5A, the pulses have a range of duty cycles of 32%-100% depending on the magnitude of the applied voltage.

As further described at col. 13, lines 24-40, during the closing period T_1, if the iron cores have not collided as represented by an input from the closing pulse computing circuit 17, the movable section displacement computing circuit 19 drops the levels of P or Q around 30% as represented by the pulses i and j in wave form (e) of Fig. 6. Subsequently, after start of the collision of the iron cores, the original state of P or Q is restored to provide the pulses h in wave form (e) of Fig. 6. The reduction in pulse width of pulses i and j reduces the current in the coil 120 as shown at corresponding points in curve (f). Thus, it is possible to minimize an impact in the point contact or collision of iron cores as well as suppress the bounce of the movable section.

At column 13, lines 56-63, the switching from the closing operation to the maintenance operation is described as occurring upon the "output from the timer circuit 16 switching the pulse computing circuit (from circuit 17 to circuit 18) from closing to maintenance when a <u>specified period</u> from start of load of voltage until completion of closing." The specified period is represented by the period T_1 of curve (e) in Fig. 6, and there is no description to indicate that the timer 16 in any way changes the duration of the specified period of T_1.

Upon switching to the maintenance mode, the comparator 82 provides output pulses illustrated by curve I of Fig. 4 in a similar manner as previously described. As shown in Fig. 5B, the pulses have a range of duty cycles of 3.2%-20% depending on the magnitude of the applied voltage. That reduced width pulse k of curve (e) of Fig. 6 results in a substantially constant, lower maint nanc curr nt through the coil 120 as shown in curve (f).

In vi w of the above, Applicant submits that the descriptions in Ohtsuka relating to varying a pulse width refer to the pulses g, h, i and j

illustrated in curve (e) of Fig. 6 during the time T_1. Varying the pulse widths of those pulses is effective to control the current in the coil 120; and Applicant further submits that the duration of the closing operation T_1 of curve (e) in Fig. 6 is a fixed, specified period that is determined by the timer circuit 16.

A prima facie case of obviousness is not made because Nojima and Ohtsuka et al. neither alone nor in combination disclose or suggest the claimed inventions. Each of the independent claims requires an output signal be applied to a coil or solenoid having an initial peak current with a variable duration followed by a hold current, wherein the duration of said initial peak current varies as a function of the power supply voltage. As described at page 10 of the application, line 11 through page 13, line 5 and elsewhere, referring to Fig. 4, the PWM 130 is operated at a set, for example, 100%, duty cycle for the duration of the peak current. A delay circuit 132 controls the duration of the peak current as an inverse function of the power supply voltage. Thus, the greater the power supply voltage, the shorter the duration of the peak current. At the end of the peak current duration, the duty cycle of the PWM 130 is reduced to provide the hold current to the solenoid.

In Nojima, the pull-in or peak current duration is selectable by the operator, but once selected, is fixed during the operation of the solenoid. In Ohtsuka, as shown in curve (e) of Fig. 6, the pulses g, h, i and j driving the second switching element are pulse width modulated to vary the magnitude of the current in the coil 120 as shown in curve (f) of Fig. 6. However, the duration of the higher magnitude closing current by T_1 of curve (e) is fixed and controlled by the operation of timer circuit 16.

A prima facie case of obviousness is not made because Nojima and Ohtsuka et al. are directed to different problems than the claimed invention. Nojima is directed to providing a power supply that can be connected to a range of line voltages. Ohtsuka is directed to providing an electrical contactor that can be connected to different voltages as well as mitigating th physical impact of the movable core colliding with a fix d iron core.

In contrast, the claimed invention is directed to improving the performance of a dispensing valve by simply using a higher voltage power supply without having to replace a valve driver circuit and without operating the coil inefficiently. Improving the performance of a dispensing valve often means operating the dispensing valve at a higher dispensing rate, for example, increasing the dispensing rate from 10 cycles per second to 20 cycles per second. As discussed at page 14, lines 25-29, "...with the higher voltage power supply, the duration of the peak current is automatically shortened. By shortening the duration of the peak current to match the response time of the dispensing valve, no more current than is required is provided to the coil and therefore, no more heat than necessary is generated by the coil."

Applicant submits that none of the cited references describe, suggest or motivate one to vary the duration of the peak current as required by the claims. Therefore, Applicant submits that claims 1-4, 16 and 19 and 21-23 are patentable and not obvious under 35 U.S.C. §103(a) over Nojima in view of Ohtsuka.

Applicant submits that the application is now in condition for allowance and reconsideration of the application is respectfully requested. The Examiner is invited to contact the undersigned in order to resolve any outstanding issues and expedite the allowance of this application.

Respectfully submitted,

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